Indiana Department of Education

SUPPORTING STUDENT SUCCESS

ISTEP+: Algebra I

End-of-Course Assessment

Released Items and Scoring Notes

Introduction

Indiana students enrolled in Algebra I participated in the *ISTEP+: Algebra I Graduation Examination* End-of-Course Assessment (ECA) during the 2010-2011 test administration windows. The Algebra I ECA consists of four item types which contribute to a student's scale score: multiple-choice, constructed-response, gridded-response and graphing items. It is important to keep in mind that a significant portion of a student's score is calculated from the multiple-choice items on the assessment, which are not addressed within this document.

This document consists of open-ended items from the Spring 2011 administration and includes:

- Sample released open-ended questions
- Rubrics used by trained evaluators to score student responses
- Sample papers used by trained evaluators to distinguish between rubric score point values
- Annotations describing the rationale for scoring student responses

The purpose of this guide is to provide additional Algebra I ECA sample items and to model the types of items that are scored using rubrics.

Reporting Category 1: Solving Linear Equations and Inequalities

Question 1

Marcos has \$5.45. He pays \$1.25 for a bus ticket. He will buy some snacks before getting on the bus. Each snack costs \$0.75.

Write a linear equation that can be used to find the maximum number of snacks (x) Marcos can buy.

Answer_____

What is the maximum number of snacks Marcos can buy?

Answer_____

Exemplary Response:

- $0.75x = 5.45 - 1.25$

    Or other equivalent equation

And

- 5

Rubric:

2 points: Exemplary response
1 point: One correct component, or a correct value in Part B based on an incorrect linear
                equation from Part A
0 points: Other

Question 1, Sample A – 2 points

> **Part A:** $4.20 = .75x$
>
> **Part B:** 5
>
> *Notes: This response is equivalent to the exemplary response.*

Question 1, Sample B – 1 point

> **Part A:** $75x + 1.25 = 5.45$
>
> **Part B:** 5 snacks
>
> *Notes: This response shows a correct solution in Part B; however, the equation in Part A is incorrect. Students must be precise when communicating about mathematics, such as when representing the value of money. Based on the equation given in Part A, it appears that the student has properly represented $1.25 and $5.45; however, 75 cents is shown as 75 dollars, which is a flaw.*

Question 1, Sample C – 0 points

> **Part A:** $5.45/.75 = x$
>
> **Part B:** 12
>
> *Notes: This response shows an incorrect equation and an incorrect solution. If the student had solved the incorrect equation correctly (x = 7 snacks in Part B), then the student would have received 1 point.*

Reporting Category 2: Graphing and Interpreting Linear and Non-Linear Relations

Question 2

What are the x- and y-intercepts of the graph of $2x - 7y = 14$?

x-intercept =

> Answer_____

y-intercept =

> Answer_____

Exemplary Response:

- *x*-intercept: (7,0) or *x*-intercept = 7
- *y*-intercept: (0,-2) or *y*-intercept = -2

Or other equivalent responses

Rubric:

2 points: Exemplary response; two correct intercepts given
1 point: One correct intercept given, or intercept values switched
0 points: Other

Question 2, Sample A – 2 points

> **Part A:** (7,0)
> **Part B:** (0,-2)
>
> *Notes: This response is equivalent to the exemplary response.*

Question 2, Sample B – 1 point

> **Part A:** 7 = x-intercept
> **Part B:** 2 = y-intercept
>
> *Notes: This response gives the correct x-intercept; however, the y-intercept is incorrect. It is likely that the student lost sight of the minus sign when calculating the y-intercept. It may be helpful to remind students before the test, and in working with mathematics in general, to consistently check their work and pay close attention to details. This error may also be due to a lack of understanding of operations within equations. It may help some students to think of the equation as 2x + (-7y) = 14.*

Question 2, Sample C – 1 point

> **Part A:** -2
> **Part B:** 7
>
> *Notes: This response gives the correct intercept values switched. This response receives 1 point.*
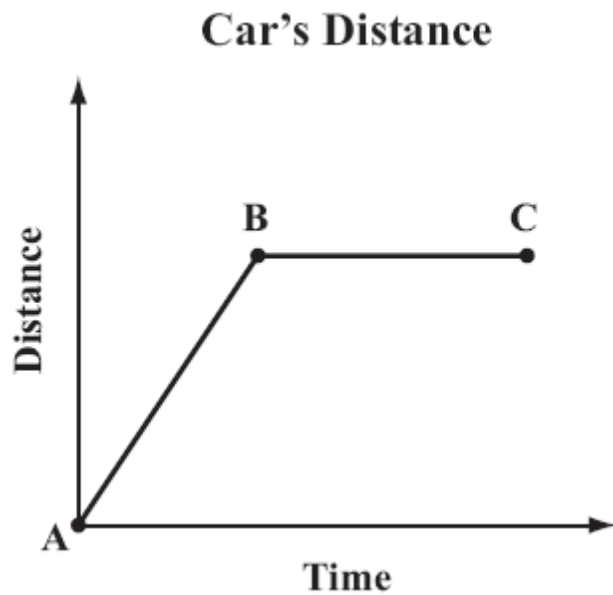
Question 2, Sample D – 0 points

> **Part A:** 2
> **Part B:** -7
>
> *Notes: This response gives two incorrect intercepts.*

Question 3

The graph below shows the distance traveled by a car over time.

Car's Distance

Describe the speed of the car from A to B.

Describe the speed of the car from B to C.

Exemplary Response:

- The car is traveling at a constant speed from A to B.

  Or other equivalent response

And

- The car's speed is zero from B to C.

  Or other equivalent response

Rubric:

2 points: Exemplary response; correctly describes the speed in both intervals
1 point: One correct component; correctly describes the speed in one interval
0 points: Other

Question 3, Sample A – 2 points

> **Part A:** The speed of the car stays the same.
> **Part B:** The car is stopped and has no speed.
>
> *Notes: This response is equivalent to the exemplary response.*

Question 3, Sample B – 1 point

> **Part A:** The speed of the car from "A" to "B" increases the whole time.
> **Part B:** The cars speed was at "0" or zero from point "B" to "C".
>
> *Notes: This response provides a valid description of the car's speed in Part B; however, the description in Part A is incorrect. This is a common error when interpreting graphs that display distance with respect to time. This student recognized that speed was being displayed; however, the student misinterpreted the graph when stating that the "speed increases the whole time". Students must recognize that the distance, not speed, increases with respect to time in this graph. They must also recognize that speed (distance/time) is being displayed in this graph, and the speed shown is constant.*

Question 3, Sample C – 1 point

> **Part A:** The car is driving at a constant rate from point A to point B.
> **Part B:** The car is increasing speed from point B to point C.
>
> *Notes: This response provides a valid description of the car's speed in Part A; however, the description in Part B is incorrect.*

Question 3, Sample D – 0 points

> **Part A:** The speed of the car from A to B is that it gains speed and goes faster.
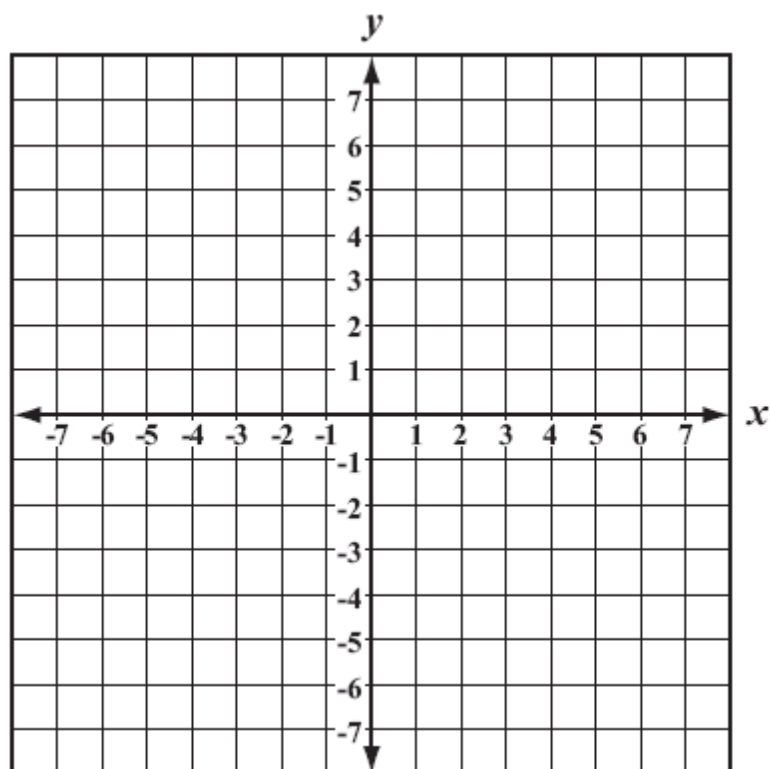> **Part B:** The speed from B to C of the car is that it is not going as fast, it slowed down.
>
> *Notes: Both descriptions are incorrect.*

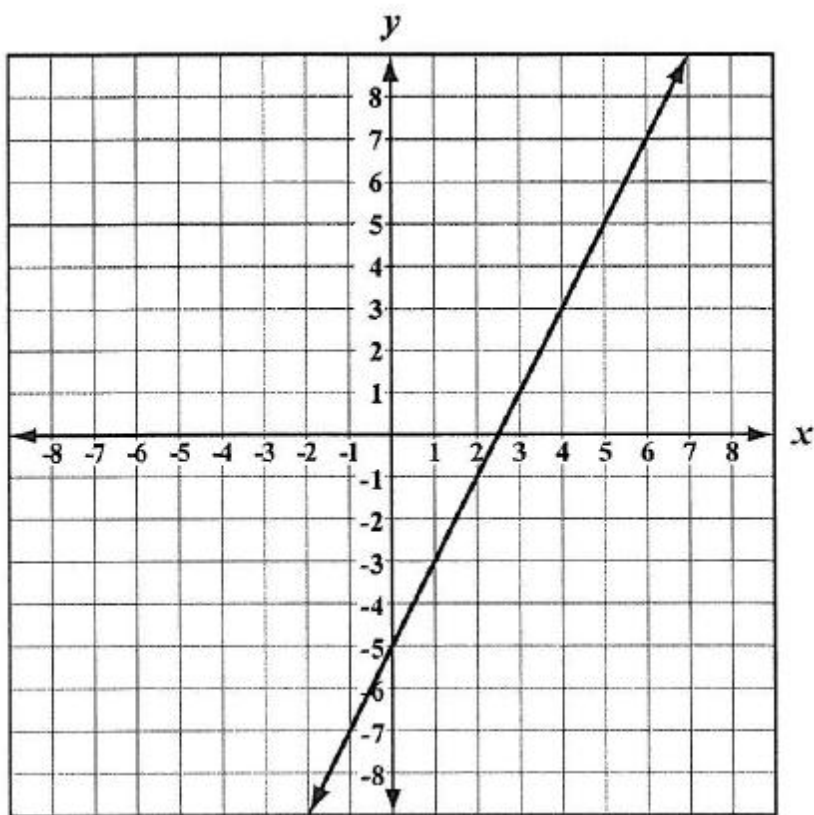**Reporting Category 2: Graphing and Interpreting Linear and Non-Linear Relations**

Question 4

Graph: $y = 2x - 5$

Exemplary Response:

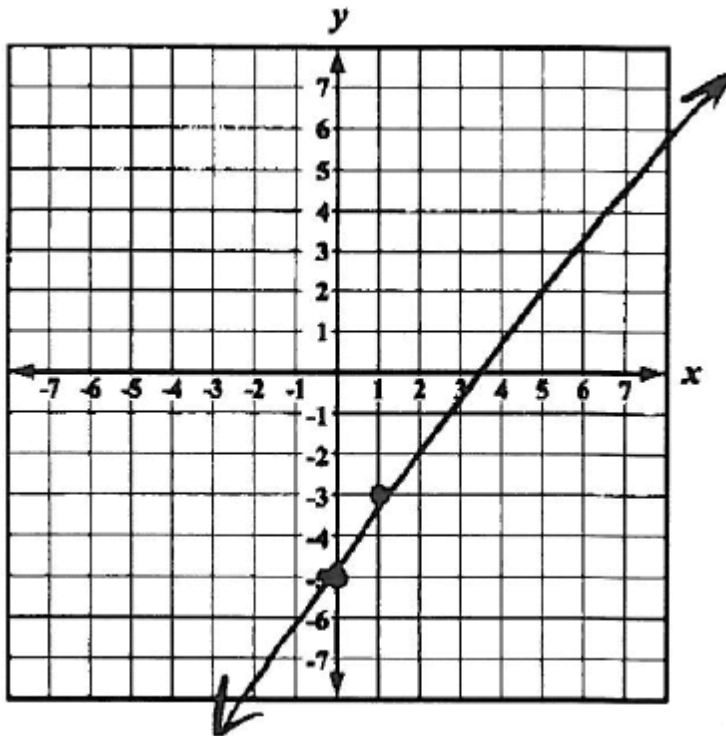- The graph of $y = 2x - 5$.

Rubric:

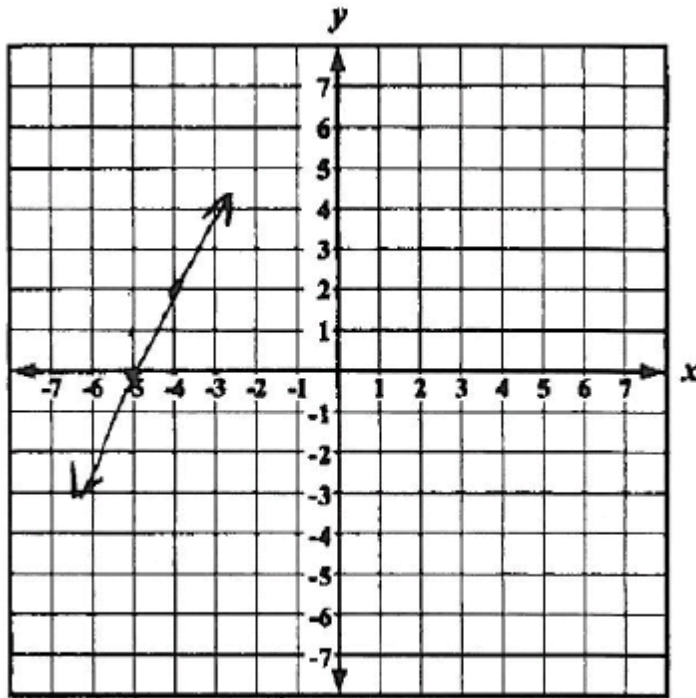1 point: Exemplary response
0 points: Other

Note: No points will be awarded if more than 1 line is graphed or additional incorrect points are plotted.

Question 4, Sample A – 1 point

Notes: This response is equivalent to the exemplary response.

Question 4, Sample B – 0 points

Notes: *This response is incorrect. The student uses the slope correctly; however, the y-intercept of -5 is incorrectly plotted on the x-axis instead of the y-axis.*

Question 5

Marcy tried to solve the equation below. She made an error.

Her work is shown below.

$$3(2x + 1) - 8x = 17$$

$$6x + 3 - 8x = 17$$

$$-2x + 3 = 17$$

$$-2x = 20$$

$$x = -10$$

Describe the error Marcy made.

_____

_____

Solve the equation $3(2x + 1) - 8x = 17$ for x.

Answer_____

Exemplary Response:

- Marcy added 3 and 17 to get 20 on the right side of the equation.

  Or, in the third step, Marcy should have subtracted 3 from both sides of the equation.

  Or, Marcy should have $-2x = 14$ instead of $-2x = 20$.

  Or other acceptable description of the error
    Note: The student's response may reference what was done incorrectly or what should have been done to solve the equation correctly.

And

- $x = -7$

Rubric:

2 points: Exemplary response
1 point: One correct component; acceptable description of the error provided in Part A, or correct solution given in Part B
0 points: Other

Question 5, Sample A – 2 points

> **Part A:** She should have subtracted 3 from 17 because she switched sides of the equal sign.
>
> **Part B:** x = -7
>
> *Notes: This response is equivalent to the exemplary response.*

Question 5, Sample B – 1 point

> **Part A:** She added the 3 to the seventeen instead of subtracting it.
>
> **Part B:** x = 7.5
>
> *Notes: This response gives a correct description of the error in Part A; however, the answer in Part B is incorrect.*

Question 5, Sample C – 1 point

> **Part A:** She did not set the equation equaled to zero. She added and subtracted wrong
>
> **Part B:** x = -7
>
> *Notes: This response gives the correct solution in Part B; however, the response in Part A does not provide an acceptable description of the error. It may be helpful for some students to solve the equation themselves before trying to find the error in "Marcy's" work. Nonetheless, students should be given several opportunities throughout the year to critique the reasoning of others in the form of written work and verbal arguments.*
>
> *Classroom Extension: A warm-up activity for this type of learning is to show students two pictures that are nearly identical, only one of the pictures has slight differences. Ask students to identify the differences between the two pictures. Tell them that the work is like that of a detective with respect to searching for "clues" and having to pay close attention to detail. This may help to motivate some students when critiquing others' work regarding math problems.*

Question 5, Sample D – 0 points

> **Part A:** She didn't subtract 6x. she added it insted.
>
> **Part B:** 14x = 20
>
> *Notes: The response in Part A does not provide an acceptable description of the error and the response in Part B is incorrect.*

Question 6

• **Alice walked at a constant speed from her home to a park in 5 minutes.**

• **Alice then stopped and rested at the park for 10 minutes.**

• **Then she walked at a constant speed back to her home in 5 minutes.**

Sketch a graph to represent Alice's distance from home over time for the 20 minutes described above.

Alice's Distance from Home
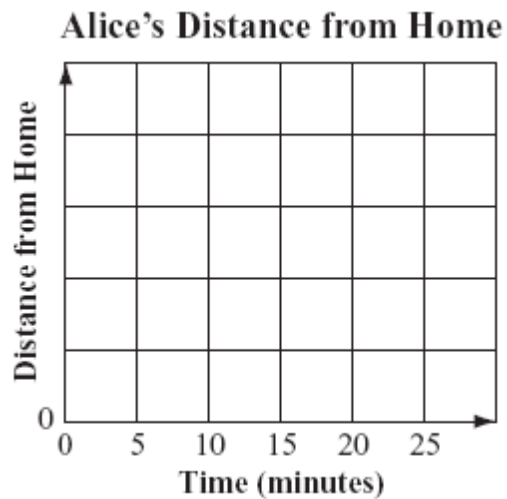
Exemplary Response: (There are 3 key elements.)

- Line segment with a positive slope from 0 – 5 minutes
- Line segment with zero slope (horizontal line) from 5 – 15 minutes that connects the end points of the other two line segments
- Line segment with a negative slope from the end of the horizontal line segment at 15 minutes to the point (20, 0)
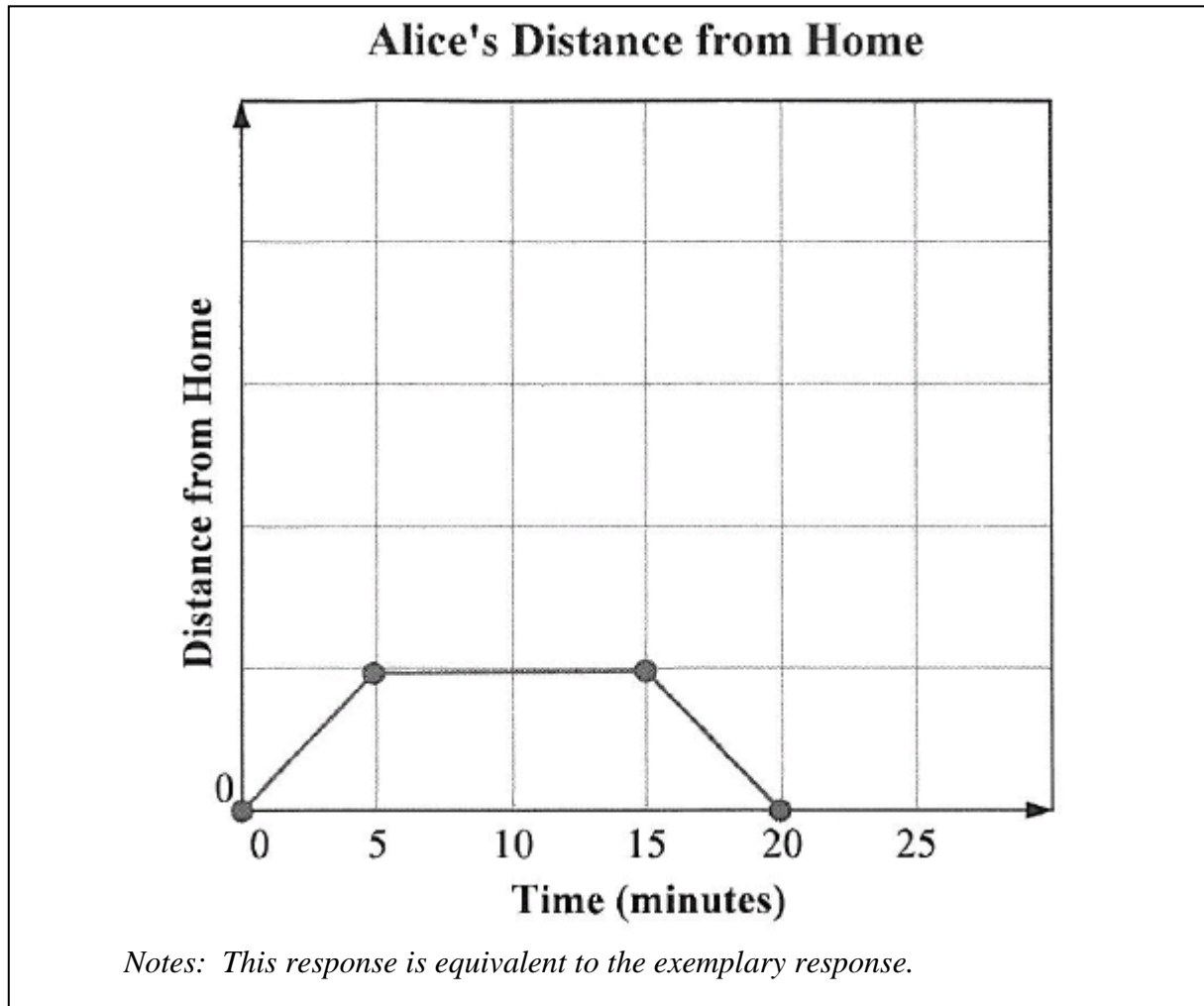
Example:
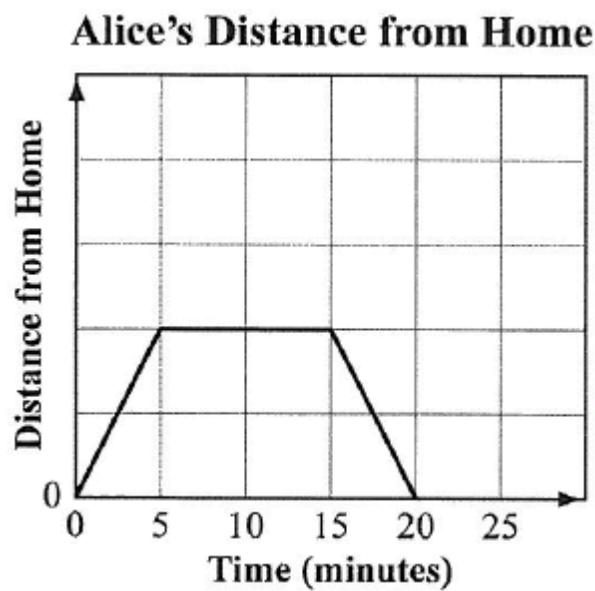
Rubric:

2 points: Exemplary response
1 point: Two key elements, or the correct general shape of the graph
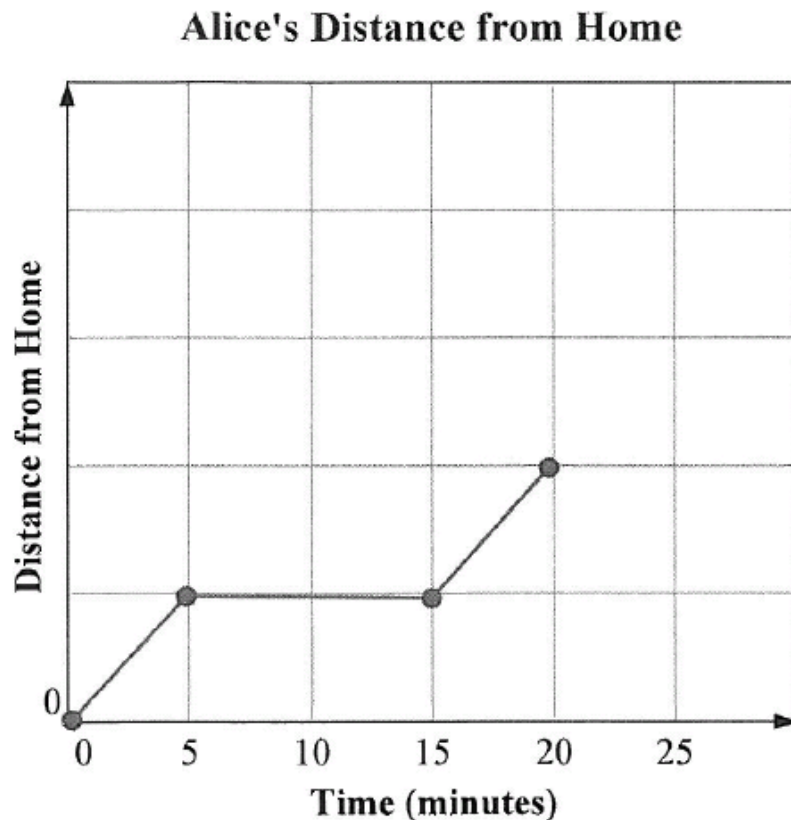0 points: Other

Question 6, Sample A – 2 points

Alice's Distance from Home

Notes: This response is equivalent to the exemplary response.

Question 6, Sample B – 1 point

Alice's Distance from Home
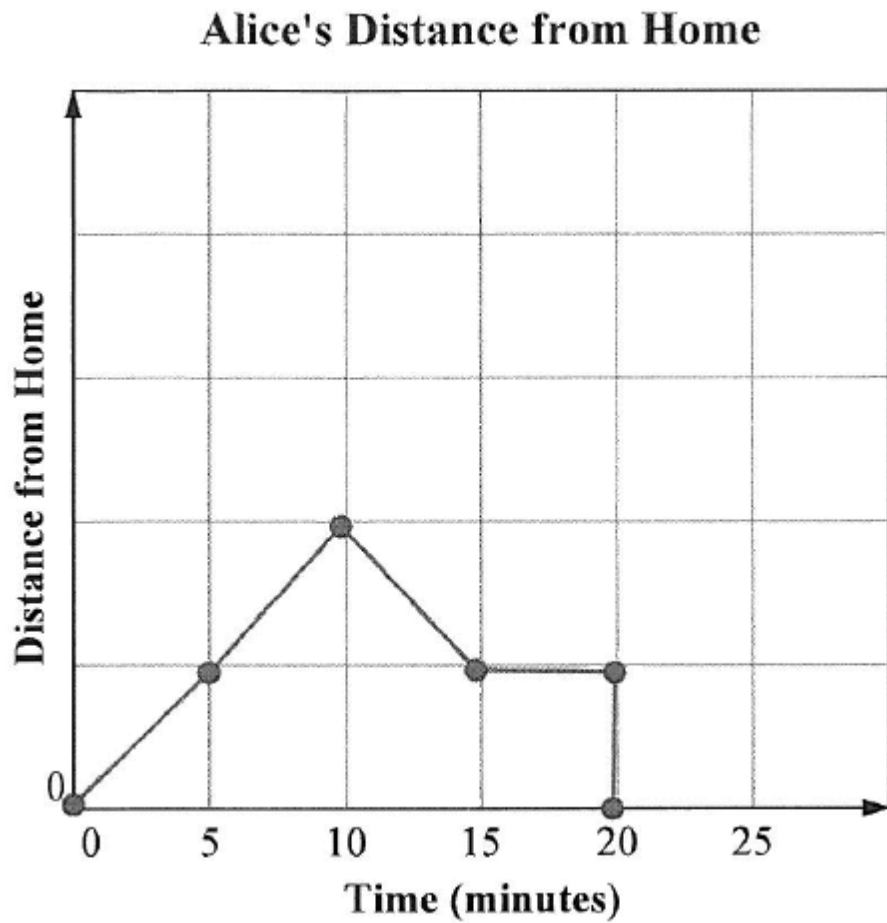
Notes: This response shows two correct key elements. This response shows a line segment with a positive slope from 0 – 5 minutes. This response also shows a line segment with zero slope from 5 – 15 minutes that connects the end points of the other two line segments. However, the final line segment should end at the point (20, 0).
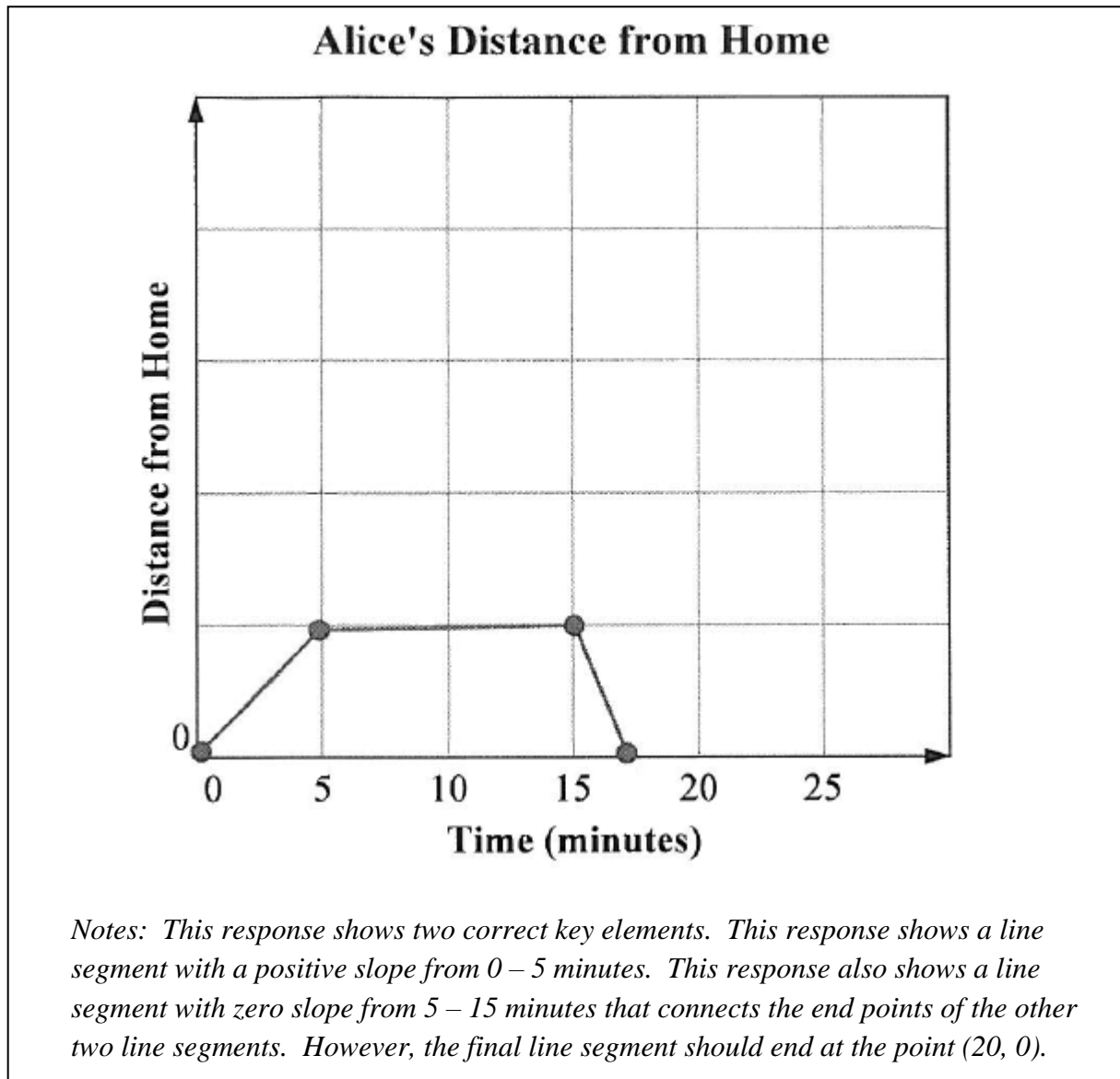
Question 6, Sample C – 1 point

Alice's Distance from Home

Notes: This response shows two correct key elements. This response shows a line segment with a positive slope from 0 – 5 minutes. This response also shows a line segment with zero slope from 5 – 15 minutes that connects the end points of the other two line segments. However, the final line segment should end at the point (20, 0). This student most likely interpreted "Distance from Home" to be total distance traveled, which is a common error. Students must attend to precision and pay close attention to details when communicating about mathematics and solving mathematical problems.

Classroom Extension: It may be helpful to show students this response with the y-axis label and title left blank. Then, ask students to interpret the graph. They should realize that the y-axis label is necessary to interpret the meaning of the graph (a title is helpful, too). This will help some students realize the importance of attending to precision when communicating about mathematics. Next, ask students for possible ideas of what the y-axis label might represent. This could lead to rich discussion about independent and dependent variables. Finally, show students the exemplary response without the y-axis label and title, and ask them to think about what the y-axis label might represent.

Question 6, Sample D – 0 points

Alice's Distance from Home

Notes: This response does not show at least two correct key elements, nor does it show the correct general shape of the graph. This response receives zero points.

Reporting Category 5: Solving and Graphing Quadratic Equations

Question 7

Solve: $x^2 + 7x = 18$

Answer_____

Exemplary Response:

- $x = -9, 2$

Rubric:

2 points: Exemplary response
1 point: One correct solution; or solutions of $x = 9, -2$; or a correct answer left unsimplified,
such as $x = (-7 \pm 11) \div 2$
0 points: Other

Question 7, Sample A – 2 points

> **Answer:** x = -9, x = 2
>
> *Notes: This response is equivalent to the exemplary response.*

Question 7, Sample B – 1 point

> **Answer:** x = 9, x = -2
>
> *Notes: This response shows the opposite values of the solutions. This response receives one point.*

Question 7, Sample C – 0 points

> **Answer:** 4x = 9 so x = 9/4
>
> *Notes: This response is incorrect.*

Question 8

Solve the system of equations below.

$$3x + 2y = 28$$
$$-3x + 2y = 4$$

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┌─────────────────────────────────────┐
│                                       │
│                                       │
│  Answer_____ │
│                                       │
└─────────────────────────────────────┘
```

Exemplary Response:

- (4, 8) or $x = 4$ and $y = 8$

Rubric:

2 points: Exemplary response
1 point: Correct x- or y-value; or correct values switched; or a correct x-value based on an incorrect y-value; or a correct y-value based on an incorrect x-value
0 points: Other

Question 8, Sample A – 2 points

> **Answer:** (4, 8)
>
> *Notes: This response is equivalent to the exemplary response.*

Question 8, Sample B – 1 point

> **Answer:** y = 28, x = 4
>
> *Notes: This response shows a correct x-value; however, the y-value is incorrect.*

Question 8, Sample C – 1 point

> **Answer:** (-4/3, 16)
>
> *Notes: This response shows a correct x-value based on an incorrect y-value. A likely scenario is that this student made an error when combining the pair of equations. This student may have added the equations incorrectly, coming up with 2y = 32 instead of 4y = 32. This student may have added the constant values on the right side of the equations correctly, but failed to add the y-values on the left side of the equations. This is a common error. Proceeding with the equation 2y = 32, the student would have found the y-value to equal 16. Then, substituting 16 for y in the first equation (3x + 2y = 28) would yield an x-value of -4/3.*
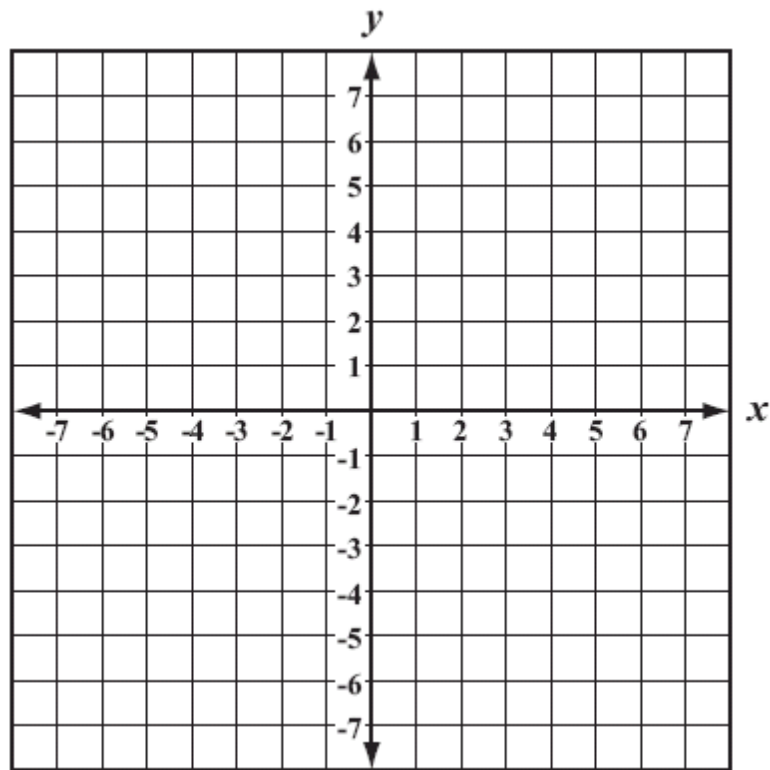
Question 8, Sample D – 0 points

> **Answer:** x = 3 y = 2
>
> *Notes: This response shows an incorrect x-value and an incorrect y-value.*

Question 9

Graph: $y < 2x - 1$

Exemplary Response:
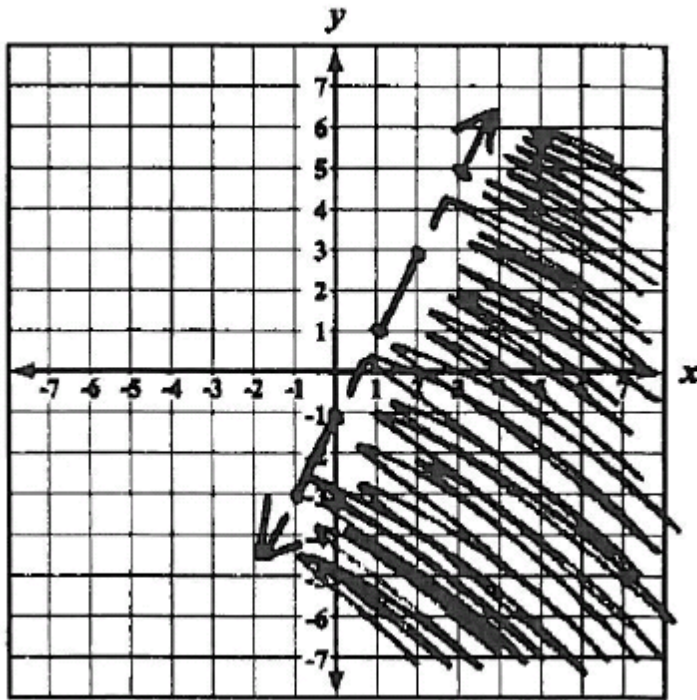
- The graph of $y < 2x - 1$
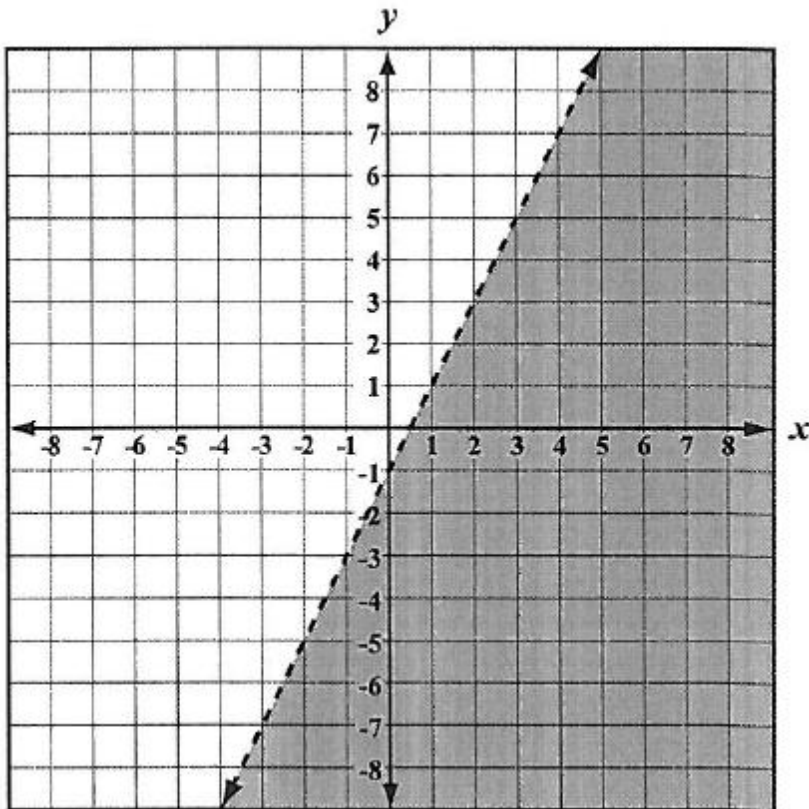
Rubric:

2 points: Exemplary response
1 point: The graph of $y = 2x - 1$ using a solid or dashed line with incorrect or no shading; or an incorrect dashed line shaded correctly
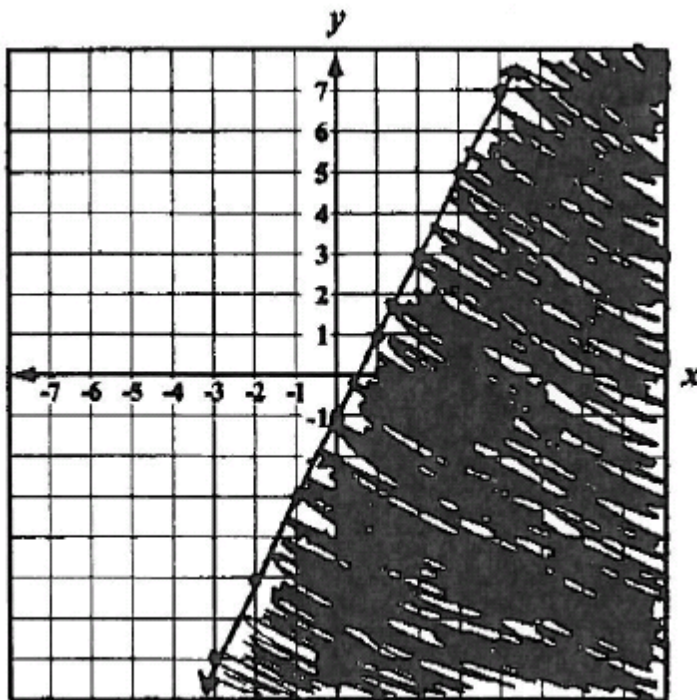   Note: If more than 1 line is graphed or additional incorrect points are plotted, no points will be awarded.
0 points: Other

Question 9, Sample A – 2 points

Notes: This response is equivalent to the exemplary response.

Question 9, Sample B – 1 point

Notes: This response shows the correct line to represent the equation y = 2x – 1, and the shading is correct. However, the line should be dashed instead of solid. Precision is critical when communicating about mathematics. It is important to stress the meaning of the inequality symbols and what they convey when representing a solution set to a linear inequality.

Classroom Extension: The response above is a good example to share with students and ask them to determine if the solution set represented in the graph is correct. Ask students to substitute points into the original inequality. Is the inequality true when you substitute points from the shaded section? What about the un-shaded section? What about points that lie directly on the boundary line?

Question 9, Sample C – 1 point
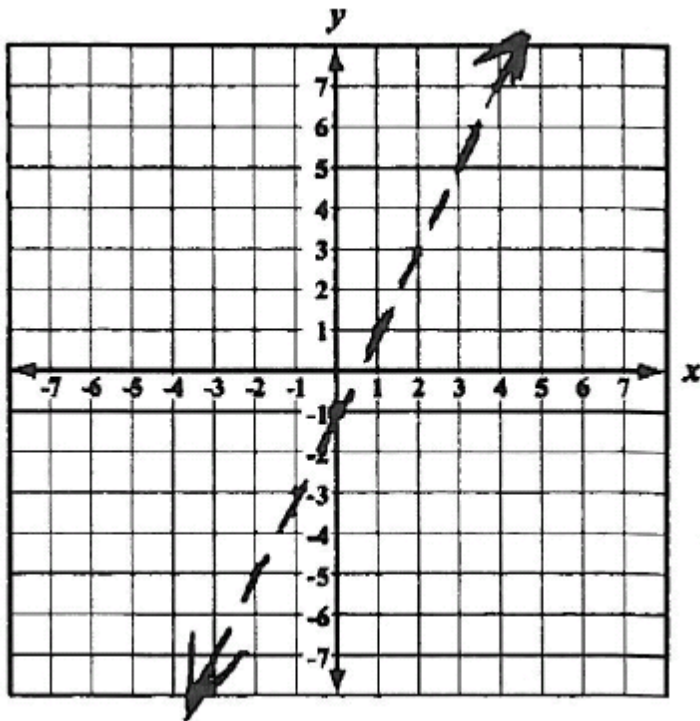
Notes: This response shows the correct line to represent the equation y = 2x – 1, and the line is appropriately dashed. However, there is no shading to indicate the solution set of this inequality.

Classroom Extension: Share this type of response with students and ask them what this graph represents. It may be helpful to graph a 2-variable linear equation first and discuss what the line represents with respect to the equation. Students can discover, by substituting points that lie on the line into the equation, that these points will make the equation true. Students can then transfer this knowledge to inequalities and discover the meaning of solid versus dashed lines, and shaded regions versus un-shaded regions.

Question 9, Sample D – 0 points
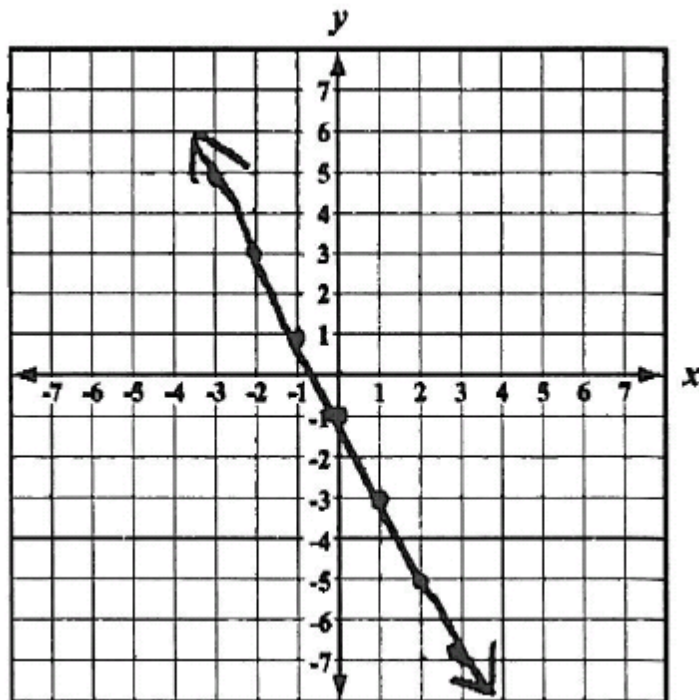
Notes: This response shows the y-intercept plotted correctly. However, this student used a slope of -2 instead of 2 to create the line. Also, the line should be dashed instead of solid, and shading is needed to indicate the solution set of the inequality.